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Analysis of Antibiotic Drug Utilization in Pediatric Pneumonia Patients at Cilacap Regional Public Hospital Using the ATC/DDD Method and DU 90%

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ABSTRACT

The high incidence of infectious pneumonia will increase the use of antibiotics. This disease is a leading cause of death in children under 5 years of age. The objective of this study was to describe the use of antibiotics for pneumonia in pediatric patients pediatric under the age of five who were treated at RSUD Cilacap in 2022. The research method used was a descriptive study with retrospective data collection, referring to medical record data. Samples were taken using the total sampling method and evaluated using the ATC/DDD and DU 90% methods. The results showed that male pediatric patients were more prevalent (55.55%) with the highest age group being 0-1 years (40.27%). The most frequently used antibiotic was Ceftriaxone (45.06%). The highest DDD/100 bed days value was for Azithromycin at 52.14, and the lowest DDD/100 bed days value was for Metronidazole at 0.31. The antibiotic with the highest DU 90% value was Azithromycin (65.22). This study concludes that stricter monitoring of antibiotic use in pediatric with pneumonia is needed, along with broader interventions to reduce overuse and prevent future antibiotic resistance

Keywords : Pneumonia, Antibiotic, ATC/DDD, DU 90%

INTRODUCTION

Pneumonia is an infectious disease of the lung parenchyma caused by various organisms and is the leading cause of death in children, particularly those under five years old (Roselany & Surjono, 2023; Mackenzie, 2016). According to WHO (2020), pneumonia claimed the lives of 740,180 children under the age of 5 in 2019, accounting for 14% of all deaths in children under five, but 22% of all deaths in children aged 1 to 5 (Supriani & Wulandari, 2022). The Health Profile of Cilacap Regency 2021 mentions that in Cilacap Regency, pneumonia cases in toddlers were found to be 1,079 cases, an increase compared to the previous year, which reached 528 cases (Dinkes Cilacap, 2021)

The high prevalence of infectious diseases will lead to an increase, and can even trigger the imprudent use of antibiotics (Prasetya et al., 2023). The high intensity of antibiotic use in patients with pneumonia can lead to various problems, especially an increase in morbidity and mortality, resistance, and the financial burden on these patients (Surya, 2014; Pani et al., 2015)

WHO has established a specific and standardized method for classifying antibiotic use, the Anatomical Therapeutic Chemical (ATC) classification, and measuring the quantity of antibiotics by Defined Daily Dose (DDD)/100 patients/day. Quantitative evaluation using the DDD method is one effort to enhance prudent antibiotic use (Ridwan et al.,

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2019). The DU 90% value can serve as a benchmark for assessing adherence to guidelines and regulations, as well as the effectiveness of the corresponding formulary utilization (WHO, 2022). Research conducted by Mahmudah et al. (2016) in the digestive surgery department of a hospital in Bandung found that the most widely used antibiotic was ceftriaxone at 8.77% DDD/100 bed days, and the antibiotics within the 90% segment included ceftriaxone, metronidazole, cefixime, cefepime, ciprofloxacin, and meropenem.

To evaluate the antibiotic usage patterns in pediatric pneumonia management and promote rational prescribing practices to combat antibiotic resistance, it is essential to conduct an analysis of antibiotic utilization using the ATC/DDD (DDD/100 bed days) and DU 90% methods

METHODOLOGY

This study is a descriptive study with a retrospective data collection method, accessing the medical records of pneumonia patients who received antibiotic therapy and were hospitalized at RSUD Cilacap in 2022. The following were the inclusion criteria for this study: From January 1 to December 30, 2022, pediatric children under the age of five who were diagnosed with pneumonia at RSUD Cilacap by a doctor had full, legible, and unambiguous medical record data, including patient identification and antibiotic use profile (drug name, route, dose, frequency, and duration). Patients who did not take topical antibiotic treatment and those with pneumonia who either died or left the hospital against medical advice were excluded from consideration. Samples were collected using total sampling, and the samples were then evaluated using the ATC/DDD and DU 90% methods.

RESULT AND DISCUSSION

Patient demographics

Table 1. Demographic characteristics

No	Demographic Characteristics	Number	%
1	Gender		
	Female	32	44.44 %
	Male	40	55.55 %
	Total	72	
2	Age (years)		
	0 - < 1	29	40.27
	1 - < 2	12	16.67
	2 - < 3	12	16.67
	3 - < 4	11	15.27
	4 - < 5	3	4.16
	5 Tahun	5	6.94
	Total	72	
3	Total Length Of Stay (LOS)	327	

Based on Table 1, there were 40 male patients (55.55%) and 32 female patients (44.44%). According to the Indonesian Health Profile (2019), there were more reported cases of pneumonia in male children compared to female children. This gender disparity in pneumonia cases may be attributed to societal biases that result in greater attention-seeking and healthcare-seeking behavior for males than females (Roselany & Surjono, 2023). The higher percentage of hospitalized male patients is due to females having lung organs with lower resistance to airflow and higher conductivity, resulting in smoother air circulation in the respiratory cavity. This protects the lungs from pathogen infections (Teguh Hary Kartono, 2023). Among the age groups, aged 0 to <1 year had the highest number of patients, with 29 individuals (40.27%), while the lowest number was in the 5year-old age group, with 5 individuals (6.94%). Research conducted by Nalang et al. (2018) indicated that the 0 to <1-year-old age group is particularly vulnerable to pneumonia. A study in Ethiopia found that children aged 2-12 months were 2.5 times more likely to contract pneumonia compared to children over 12 months old (Abuka, 2017). This increased susceptibility is due to their underdeveloped immunity, which reduces their resistance to infectious diseases, making infants more prone

to pneumonia. Additionally, they have relatively narrow respiratory tracts (Kiconco et al., 2021).

Length of Stay (LOS) refers to the duration a patient remains hospitalized for treatment of their condition until discharge (Sukmawati). LOS is used in the calculation of DDD, where it serves as a divisor along with the standard WHO dose. The DDD per 100 inpatient days decreases as LOS increases (Hadi et al., 2008). Based on Table 1, Length of Stay (LOS) is 327 days from 72 pediatric patients, with an average of 4.54 days.

This indicates that pediatric pneumonia patients at RSUD from January to December 2022 had an average inpatient stay of 4.54

days. According to the Centers for Disease Control and Prevention in the United States, children hospitalized for pneumonia treatment typically spend an average of five days in the hospital (Kuti et al., 2014).

The study conducted by Amare et al.(2021) found that the average recovery time from severe pneumonia in children aged 2–59 months is estimated to be four days. This short duration may indicate high-quality care and the adherence of service providers to standard treatment.

The Antibiotic Use Profile

Table 2. The Antibiotic Use

Antibiotic name	Types of Antibiotics	Number	%
Ceftriaxone	Cefalosporin	116	45.06
Cefotaxime		43	16,70
Azithromycin	Macrolide	33.90	13.17
Erythromycin		15.5	6.02
Ampicillin Sulbactam	Combination of Penicillin and Enzyme Inhibitors	28	10.87
Gentamycin	Aminoglykoside	18	6.99
Metronidazole	Nitroimidazoles	3	1.16
	Total	257,4	

According to the WHO Pocket Book, pneumonia is characterized by symptoms of rapid breathing and/or chest retractions. It should be treated at home with oral amoxicillin as the first-line therapy, and azithromycin can be used as an alternative if the initial treatment fails. Severe pneumonia is identified as a condition with any common danger signs, with or without rapid breathing, requiring hospital treatment. The primary therapy is intravenous ampicillin plus gentamicin, and if this is ineffective, third-generation cephalosporins such as ceftriaxone can be used as an alternative (Rashid et al., 2017).

Ceftriaxone belongs to the third-generation cephalosporin antibiotics, which serve as the second-line empirical therapy for pneumonia in children used at RSUD Cilacap (Kemenkes RI 2021).This antibiotic is rapidly absorbed and widely distributed throughout body tissues, making ceftriaxone highly effective in treating various gram-positive and gram-negative infections such as Enterobacteriaceae, Streptococcus pneumoniae, Haemophilus influenzae, and Pseudomonas aeruginosa (Juwita et al., 2023)

ATC/DDD Evaluate

The World Health Organization (WHO) has suggested using the Anatomical Therapeutic Chemical (ATC) classification system and the Defined Daily Dose (DDD) measurement to quantitatively evaluate antibiotic use. The DDD is defined as the average maintenance dose per day for an adult and is only applicable to medicines with an ATC code (Azyenela et al., 2022).

The purpose of evaluating antibiotic use with the ATC/DDD method is to provide input, improve policies, or implement more appropriate educational programs on the quantitative use of antibiotics. (Prasetya et al., 2023). Based on Table 3 it is known that the cumulative DDD value is 79.99 DDD/100 inpatient days. This indicates that the cumulative number of antibiotic doses given each day during a 100-day period of inpatient treatment is 79.99. This study's results were compared with the findings of a study by Rahmah (2022) at Wava Husada Kepanjen Hospital, which stated that the total DDD value in their study was 88.95 DDD/100 inpatient days, indicating that the value in this study is lower. The higher the DDD value, the higher the quantity of antibiotics used, increasing the likelihood of antibiotic resistance (Aseng et al., 2023). In this study, the antibiotic with the highest DDD/100 inpatient days was Azithromycin at 79.88, and the lowest was Metronidazole at 0.31, as shown in Table 3.

Azithromycin is a macrolide antibiotic belonging to the azalide group that inhibits bacterial protein synthesis by preventing the translocation of a bacterial peptide chain through binding to the 50s ribosome subunit (Parisa et al., 2022). The use of azithromycin aligns with the guidelines PDPI (2014) that recommend azithromycin as an empirical antibiotic for pneumonia patients. Azithromycin is used as a treatment for atypical pneumonia caused by M. pneumoniae, C. pneumoniae, and Legionella. This antibiotic works by inhibiting bacterial protein synthesis (Prasetya et al., 2023).

Table 3. Quantitative of Pneumonia Antibiotic Use at RSUD Cilacap Using the ATC/DDD

Code DDD	Antibiotic name	DDD WHO (gram)	Antibiotics used (gram)	DDD / 100 bed-days
J01FA10	Azithromycin	1.5	170.5	52.14
J01DD04	Ceftriaxone	2	58	17.74
J01DD01	Cefotaxime	4	10.75	3.29
J01GB03	Gentamycin	0.24	9.06	2.77
J01FA01	Erythromycin	1	7.75	2.37
J01CR01	Ampicillin Sulbactam	6	4.5	1.38
J01XD01	Metronidazole	1.5	1	0.31
Total				79.99

Drug Utilization (DU 90%)

The assessment of drugs within the 90% segment is crucial for evaluating, controlling, using, and planning the procurement of these medications, especially those included in this segment (Mahmudah et al., 2016). DU 90% assessment is conducted by arranging the cumulative percentage of antibiotics from the highest to the lowest usage and taking the 90% segment of the total medicine use (Hanifah, 2022). Based on Table 3, the antibiotic used at RSUD with the highest DU value of 90% is azithromycin (65.22) and the lowest is

Metronidazole (0.38). Antibiotics included in the DU 90% segment are Azithromycin and Ceftriaxone, while those in the 10% segment are Cefotaxime, Gentamycin, Erythromycin, Ampicillin sulbactam, and Metronidazole. Antibiotics in the DU 90% segment indicate that they are the most frequently used, whereas those in DU 10% segment are the least frequently used in antibiotic prescriptions (Zahra et al., 2023). Over the period from 2016 to 2018, the antibiotics included in the DU 90% segment at health centers were Amoxicillin, Ciprofloxacin, and Tetracycline (Andriani et al., 2021).

According to the WHO AWaRe (Access, Watch, Reserve) 2021 classification, azithromycin and ceftriaxone are categorized as "Watch" antibiotics. This classification indicates that they have a higher potential to contribute to antimicrobial resistance and are typically used for more seriously ill patients in hospital settings. Therefore, their usage requires careful monitoring to prevent overuse (Zanichelli et al., 2023). The DU 90% method indirectly suggests that the use of antibiotics within the DU 90% segment should be controlled by considering antibiotic prescription patterns (Azyenela et al., 2022).

The results of the study indicate that azithromycin and ceftriaxone dominate the DU 90% segment. This emphasizes the significance of monitoring the potential rise in antibiotic resistance to these two antibiotics. It highlights the necessity for more stringent oversight of their usage to mitigate the risk of bacterial resistance, which could compromise the effectiveness of treatment.

Table 4. DU 90% Value

Code DDD	Antibiotic name	%	Cumulative DU (%)	Segment DU 90%
J01FA10	Azithromycin	65.22	65.22	90 %
J01DD04	Ceftriaxone	22.17	87.39	
J01DD01	Cefotaxime	4.11	91.5	10%
J01GB03	Gentamycin	3.46	94.96	
J01FA01	Erythromycin	2.96	97.92	
J01CR01	Ampicillin Sulbactam	1.72	99.64	
J01XD01	Metronidazole	0.38	100	
Total		100		100

CONCLUSION

The research results showed that the highest DDD/100 bed-days value was for azithromycin (52.14). The evaluation of antibiotic usage revealed that Azithromycin and Ceftriaxone were included in the DU 90% segment, while Cefotaxime, Gentamycin, Erythromycin, Ampicillin Sulbactam, and Metronidazole fell into the DU 10% segment.

RECOMMEDATIONS

Further research using qualitative evaluation methods is necessary to validate the results and obtain a more comprehensive understanding of antibiotic prescribing behaviors. Additionally, conducting similar studies in diverse locations

can offer valuable insights into antibiotic usage in different regions, aiding in the selection of appropriate antibiotics for pediatric pneumonia

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